UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/630,444	07/29/2003	Kenichi Koyanagi	P/3236-39	7918

2352 7590 03/16/2005

OSTROLENK FABER GERB & SOFFEN
1180 AVENUE OF THE AMERICAS
NEW YORK, NY 100368403

EXAMINER	
COLEMAN, WILLIAM D	

ART UNIT	PAPER NUMBER
2823	

DATE MAILED: 03/16/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/630,444	KOYANAGI ET AL.	
	Examiner	Art Unit	
	W. David Coleman	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *07 January 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-37* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-37* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed January 7, 2005 have been fully considered but they are not persuasive.

2. Applicants contend that Basceri et al., U.S. Patent 6,753,618 B2 herein known as Basceri fails to disclose the two stage manufacturing steps as recited in claims 1-17, 19-35 and 37. Applicants further indicate that the first stage involves introducing a material gas containing a desired metal into a reaction chamber for the purpose of forming an oxide film made of the specified metal by a vapor-phase growth method. The second stage involves removing the material gas introduced into the reaction chamber at the first stage and a byproduct produced at said first stage, from the reaction chamber.

3. In response to Applicants contention that Basceri fails to teach the first stage involves introducing a material gas containing a desired metal into a reaction chamber for the purpose of forming an oxide film made of the specified metal by a vapor-phase growth method. The second stage involves removing the material gas introduced into the reaction chamber at the first stage and a byproduct produced at said first stage, from the reaction chamber. The Examiner will explain the rationale for such a teaching. In the first stage Basceri teaches a metal-organic precursor such as aluminum trichloride, ($AlCl_3$) or aluminum tetrachloride, ($AlCl_4$) is first deposited on a surface. It is well known to apply some energy to a compound to disassociate the molecules (i.e., heating the reaction chamber), otherwise the aluminum that is deposited in the Basceri disclosure will not sufficiently be pure enough to fabricate the aluminum oxide as disclosed. It is well known in the art that all the gas in the reaction chamber will not decompose

into aluminum and chlorine and therefore a portion will remain in its delivery state. Please note that since Basceri teaches the use of a vacuum system, work must be continually performed the maintain a pressure below atmospheric. Although the pump may be throttled during the formation of various films utilizing the CVD, MOCVD and ALD process, it is still required to maintain some type of pumping speed for uniform deposited films. Since the vacuum pump is constantly working the gas delivered to the reaction chamber still has throughput through out the whole system. This means that the reaction gas $AlCl_3$ or $AlCl_4$ and aluminum micro-particles will find its way to the vacuum pump in which the Applicant calls the second stage, so therefore the explanation above and the prior art rejection is being maintained and Applicants arguments are moot.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 1-17, 19-35 and 37 are rejected under 35 U.S.C. 102(e) as being anticipated by Basceri et al., U.S. Patent 6,753,618 B2.

Basceri discloses a semiconductor process as claimed. See **FIGS. 1A-13**, where Basceri teaches the claimed invention.

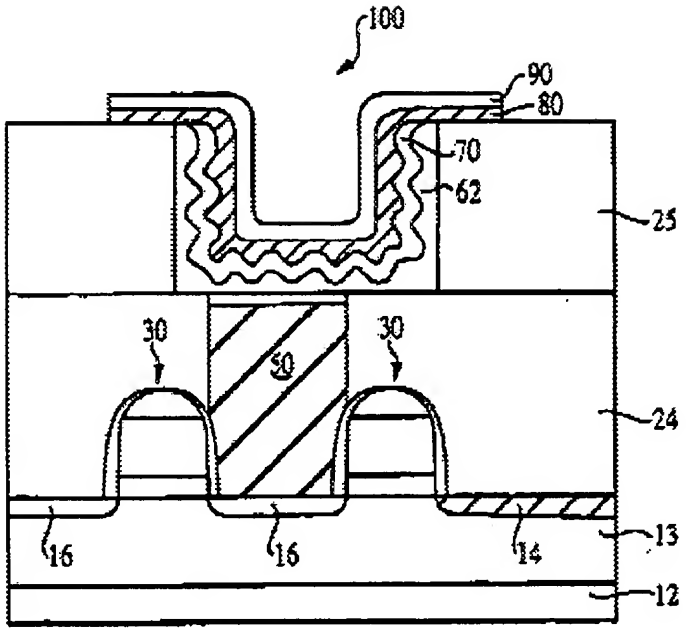

FIG. 16

6. Pertaining to claim 1, Basceri teaches a method for manufacturing a semiconductor device, comprising a dual-stage deposition step comprising:

a first stage for introducing a material gas containing

desired metal (i.e., aluminum tetrachloride) into a reaction chamber in which a semiconductor substrate **12** on a surface of which a metal film is formed in part

or in entirety is placed to thus form an oxide film made of said

specified metal by a vapor-phase growth method and the following

second stage for removing from said reaction chamber said material

gas introduced into said reaction chamber at said first stage (remove the halogen, i.e., chloride) and a byproduct produced at said first stage, and

wherein said metal oxide film as an oxide of said specified

metal is formed on said semiconductor substrate, by repeating said dual-stage deposition step two or more times (column 11, lines 5-7).

7. Pertaining to claim 2, Basceri teaches the method according to claim 1, wherein said semiconductor substrate has a cylindrical trench on a surface thereof in such a configuration that said metal film is formed on a bottom and an inner side wall of said cylindrical trench (the Examiner takes the position that since the dielectric layer **24** is amorphous, etching will occur to be uniform in a cylindrical shape).

8. Pertaining to claim 3, Basceri teaches the method according to claim 1, wherein said material gas and said byproduct produced at said first stage are removed by introducing a gas different from said material gas at said first stage into said reaction chamber at said second stage (i.e., the second gas is oxygen as taught by Basceri).

9. Pertaining to claim 4, Basceri teaches the method according to claim 1, wherein said material gas and said byproduct produced at said first stage are removed by depressurizing said reaction chamber at said second stage (it is well known to evacuate a reaction chamber when introducing a gas species having a different atomic weight during an ALD process).

10. Pertaining to claim 5, Basceri teaches the method according to claim 4, wherein after having performed said depressurizing at said second stage and before said first stages starts in a next dual-stage deposition step, a gas different from said material gas is introduced into said reaction chamber to thus recover a gas pressure before performing said depressurizing in said reaction chamber (the reasons are explained above in the rejection of claim 4).

11. Pertaining to claim 6, Basceri teaches the method according to claim 1, wherein said metal oxide film having a finally required film thickness is formed by repeating said steps a plurality of number of times.

12. Pertaining to claim 7, Basceri teaches the method according to claim 1, wherein after said steps are repeated a plurality of number of times, said material gas is introduced continuously for a time longer than that required for said first stage, to form said metal oxide film having the finally required film thickness (please note that the molecular weight of oxygen is smaller than the molecular weight of the aluminum, without specifying pumping speeds there is not enough information in the specification to dispute these facts).

13. Pertaining to claim 8, Basceri teaches the method according to claim 1, wherein an oxidizing gas is introduced at said first stage.

14. Pertaining to claim 9, Basceri teaches the method according to claim 8, wherein introduction of said oxidizing gas is started from a second-time said steps (hence, a standard technique which is well known for ALD).

15. Pertaining to claim 10, Basceri teaches the method according to claim 1, wherein said second stage comprises a process for introducing an oxidizing gas and a process for introducing said material gas and a gas different from said oxidizing gas.

16. Pertaining to claim 11, Basceri teaches the method according to claim 3, wherein said gas different from said material gas is an inactive gas (purge gas).

17. Pertaining to claim 12, Basceri teaches the method according to claim 11, wherein said inactive gas is a nitrogen gas (it is well known to use nitrogen as a purge gas for ALD).

18. Pertaining to claim 13, Basceri teaches the method according to claim 1, wherein said metal film is made of metal having a catalytic action.

19. Pertaining to claim 14, Basceri teaches the method according to claim 1, wherein said vapor-phase growth method is a chemical vapor deposition method or a physical vapor deposition method (column 9, lines 50-51).

20. Pertaining to claim 15, Basceri teaches the method according to claim 1, wherein said metal oxide film as said oxide of said specified metal is made of at least one selected from the group consisting essentially of tantalum, hafnium, zirconium, and niobium (column 9, lines 36-46, also see claim 28 of Basceri).

21. Pertaining to claim 16, Basceri teaches the method according to claim 15, wherein tantalum penta-ethoxide is used as said material gas.

22. Pertaining to claim 17, Basceri teaches the method according to claim 8, wherein a said oxidizing gas, a gas containing oxygen, ozone, water, nitrogen oxide, or oxygen radical is used.

23. Pertaining to claim 19, Basceri teaches a method for manufacturing a semiconductor device having a capacitor, comprising:
a dual-stage deposition step comprising:
a first stage for introducing a material gas containing desired metal into a reaction chamber in which a semiconductor substrate on a surface of which a metal film is formed in part or in entirety is placed to thus form an oxide film made of said desired metal by a vapor-phase growth method and the following second stage for removing from said reaction chamber said material gas introduced into said reaction chamber at said first stage and

a byproduct produced at said first stage, and

wherein said metal oxide film as an oxide of said specified metal is formed on said semiconductor substrate, by repeating said dual-stage deposition step two or more times, thereby forming a capacitive insulating film to make up said capacitor; and

forming an upper electrode to make up said capacitor on said capacitive insulating film.

24. Pertaining to claim 20, Basceri teaches the method according to claim 19, wherein said semiconductor substrate has a cylindrical trench on a surface thereof in such a configuration that said metal film is formed on a bottom and an inner side wall of said cylindrical trench.

25. Pertaining to claim 21, Basceri teaches the method according to claim 19, wherein said material gas and said byproduct produced at said first stage are removed by introducing a gas different from said material gas at said first stage into said reaction chamber at said second stage.

26. Pertaining to claim 22, Basceri teaches the method according to claim 19, wherein said material gas and said byproduct produced at said first stage are removed by depressurizing said reaction chamber at said second stage.

27. Pertaining to claim 23, Basceri teaches the method according to claim 22, wherein after having performed said depressurizing at said second stage and before said

first stages starts in a next dual-stage deposition step, a gas different from said material gas is introduced into said reaction chamber to thus recover a gas pressure before performing said depressurizing in said reaction chamber.

28. Pertaining to claim 24, Basceri teaches the method according to claim 19, wherein said metal oxide film having a finally required film thickness is formed by repeating said steps a plurality of number of times.

29. Pertaining to claim 25, Basceri teaches the method according to claim 19, wherein after said steps are repeated a plurality of number of times, said material gas is introduced continuously for a time longer than that required for said first stage, to form said metal oxide film having the finally required film thickness.

30. Pertaining to claim 26, Basceri teaches the method according to claim 19, wherein an oxidizing gas is introduced at said first stage.

31. Pertaining to claim 27, Basceri teaches the method according to claim 26, wherein introduction of said oxidizing gas is started from a second-time said steps.

32. Pertaining to claim 28, Basceri teaches the method according to claim 19, wherein said second stage comprises a process for introducing an oxidizing gas and a process for introducing said material gas and a gas different from said oxidizing gas.

33. Pertaining to claim 29, Basceri teaches the method according to claim 21, wherein said gas different from said material gas is an inactive gas.

34. Pertaining to claim 30, Basceri teaches the method according to claim 29, wherein said inactive gas is a nitrogen gas.

35. Pertaining to claim 31, Basceri teaches the method according to claim 19, wherein said metal film is made of metal having a catalytic action.

36. Pertaining to claim 32, Basceri teaches the method according to claim 19, wherein said vapor-phase growth method is a chemical vapor deposition method or a physical vapor deposition method.

37. Pertaining to claim 33, Basceri teaches the method according to claim 19, wherein said metal oxide film as said oxide of said specified metal is made of at least one selected from the group consisting essentially of tantalum, hafnium, zirconium, and niobium.

38. Pertaining to claim 34, Basceri teaches the method according to claim 33, wherein tantalum penta-ethoxide is used as said material gas.

39. Pertaining to claim 35, Basceri teaches the method according to claim 26, wherein as said oxidizing gas, a gas containing oxygen, ozone, water, nitrogen oxide, or oxygen radical is used.

40. Pertaining to claim 37, Basceri teaches a method for manufacturing a semiconductor device, performing a first stage for introducing a material gas containing desired metal into a reaction chamber in which a semiconductor substrate on a right side of which a metal film is formed is placed to thus form an oxide film made of said desired metal by a vapor-phase growth method and the following second stage for removing from said reaction chamber said material gas introduced into said reaction chamber at said first stage and a byproduct produced at said first stage and then introducing said material gas continuously for a lapse of time longer than said first stage, thereby forming an oxide film made of said metal having a finally required film thickness.

Claim Rejections - 35 USC § 103

41. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

42. Claims 18 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Basceri et al., U.S. Patent 6,753,618 B2 in view of Roberts et al., U.S. Patent 6,461,914 B2.

43. Basceri discloses a semiconductor process substantially as claimed.

44. Pertaining to claims 18 and 36, Basceri fails to teach the method according to claims 13 and 31, wherein as said metal having a catalytic action, ruthenium or platinum is used. Roberts teaches a method wherein said metal having a catalytic action is ruthenium or platinum. In view of Roberts, it would have been obvious to one of ordinary skill in the art to incorporate the ruthenium or platinum of Roberts into the Basceri semiconductor process because the material can serve as both an oxidation layer and barrier layer (column 4, lines 16-29).

Conclusion

45. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

46. A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

47. Any inquiry concerning this communication or earlier communications from the examiner should be directed to W. David Coleman whose telephone number is 571-272-1856. The examiner can normally be reached on Monday-Friday 9:00 AM-5:30 PM.

48. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 571-272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

49. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

W. David Coleman
Primary Examiner
Art Unit 2823

WDC